

NIR and Vis-NIR spectroscopy to predict PSE-like zones of ham



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Introduction

PSE-like zones are still a major concern for the meat processing industry. This structure defect of the ham is known to increase slicing losses of the phosphate-free "Jambon Cuit Supérieur" processing. PSE-like zones are difficult to detect before deboning due to their localization on the inside surface of the ham. Near Infra-Red Spectroscopy (NIRS) devices such as Labspec4[®] can be considered as alternative techniques to human subjective grading, but measurements must be conducted on deboned hams. The NitFom[™] (Frontmatec) is a NIR based measuring device dedicated to on-line measurements at high speed on hot or cold carcasses by invasive probing. The objective of the study was to evaluate the accuracy of PSE-like zone classification using NitFom[™] on bone-in hams and to compare its prediction quality with the previously tested Labspec4[®] on deboned hams.



Figure 1: Ham with PSE-like zone class 4 showing severe destructuration

Material and methods

2 spectrometers:

- NitFom[™] (995-2200 nm) - invasive probe suitable for industrial purpose
- ASDI Labspec4[®] (350-2500 nm) - surface probe dedicated to experimental measurements

Samples:

- A subpopulation of deboned hams (n=46) selected on ultimate pH value (uniform pH distribution, 6 classes: <5.5 ; 5.5-5.6 ; 5.6-5.8 ; 5.8-6.0 ; 6.0-6.2 ; >6.2) from a batch of randomly selected bone-in hams (n=146, Piétrain sire).

Spectral measurement sites:

- Invasive NitFom[™] probe: cross section of *Semimembranosus*
- Labspec4[®]: internal surface of *Semimembranosus*

Reference meat quality parameters:

- Subjective PSE-like zone classification after deboning (IFIP scale)

- Spectral prediction of PSE-like zone classification were investigated with the PLSDA cross validation procedure (MATLAB software and Eigenvector toolbox).

Table 1: Reference data set for PSE-like zones classification

		Sample selection	PSE-like zones subjective classification		
			1	2	3+4
	NitFom [™] (n=146)	random	85	36	25
	Labspec4 [®] (n=46)	uniform pH24 distribution	21	13	12

Table 2: NitFom[™] and Labspec4[®] cross validation results for PLSDA classification of PSE-like zones (subpopulation of deboned hams, n=46)

Device	Observed PSE-like zone grading	PLSDA prediction		Overall missclassification
		1+2	3+4	
NitFom [™] (n=46)	1+2	25	9	26.1%
	3+4	3	9	
Labspec4 [®] (n=46)	1+2	29	5	13.0%
	3+4	1	11	

Results

- Prediction of PSE-like zone (absence of PSE-like zone/class1+2 vs presence of PSE-like zone/class3+4): 26 % of missclassification for NitFom[™] and 13 % for Labspec4[®]
- The weight of the visible spectrum (380-780 nm) is significant in the classification model for the Labspec4[®] (figure 2)
- The higher number of missclassification for NitFom[™] may be explained by the range of wavelength collected (NIR only)
- The location of spectral measurement also differs between devices: a 2 cm wide zone of the *Semimembranosus* internal surface (Labspec4[®]) vs a 3 cm long cross section of *Semimembranosus* (NitFom[™])

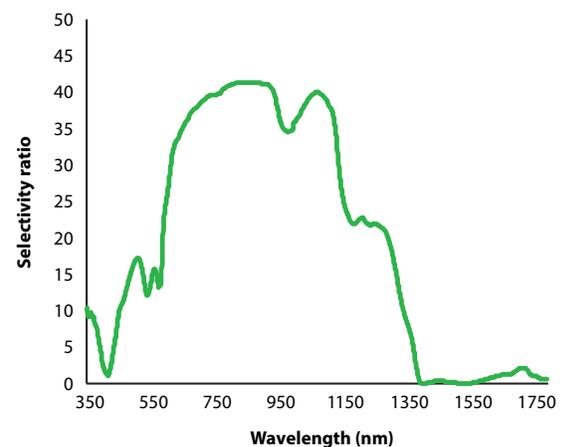


Figure 2: Labspec4[®] selectivity ratio for class1+2 vs class3+4 discrimination

Conclusion

This study confirmed that PSE-like zones could be detected with NIR spectroscopy in hams. Labspec4[®] includes the visible spectrum (Vis-NIR) and is found to be more accurate on bone-out hams at-line, but the on-line NitFom[™] (NIRS only) precision to detect deep PSE-like zone stages (class 3+4) could be a useful sorting tool for bone-in hams. Expanding the spectral range in the NitFom[™] by including the visible region might improve its accuracy.

